ENDCAP Alignment Status

September 08, 2000

Data Analysis of (June-July-Aug) ISR test runs – DCOPS + Analog

Geometric Reconstruction from ISR setup - Endcap specific solution

Global reconstruction in COCOA in progress

September Integrated test run Setup of Integrated test with CSC at Lab 7

First level analysis completion for Sept 21 Alignment Review at CERN

Alignment.dwgs for EDR including Integration, EDR outline proposal

DCOPS final pre production engineering PNPI, sensor box, filtering

Alignment schedule, installation at CERN, DAQ model and interface to SCADA

Endcap Analog Sensors - ISR

Z Transfer System

Z4MW40 Laser distance sensor; end of tube to MAB Reference surface (gap ~45 mm)
LCP8-10 potentiometer on Transfer Plate; extending the gap to opposite end of tube
AD592 Temperature sensors on the tube, Transfer Plate, ME2/2 CSC panel strip, etc.

Transfer Plate

Applied Geomechanics 900 dual axis inclinometer
AD592 Temperature sensor on the Transfer Plate

R Transfer to CSCs

LPX50 wire extension potentiometer; Transfer Plate to ME2/2 outer,
LPX50 wire extension potentiometer; ME2/2 inner to ME2/1 outer
AD592 Temperature sensors on the ME2/2 CSC panel strip, ES5 sensor, etc.

Endcap Analog Sensors - ISR

Potentiometers, Z4MW40 are voltage devices on 12V REF

AD592 temperature sensors are current sources on 12 V -> voltage divider at DAQ

Readout by HP 34970A Data Acquisition/Switch Unit (40 ch->ADC, 20 ch switch)

Measurement cycles: One read per Laser cycle (2 directions SLM) = event (302,303)
Cluster for DCOPS averaging = 8 events (4 each direction SLM)

These events used for long term stability studies

Special dedicated Burst measurement cycle; 50-200 measurements, no DCOPS

These bursts used for instantaneous resolution measurements

Endcap Analog Sensors - ISR

Short Term Resolutions: Minimum/maximum values set by noise ± 0.75 mv

Burst (200 samples) sample of 4 runs – take worst stdev

σXtilt = σYtilt = 0.52 mv = 19.54 arc sec 12 V Analog Reference σ = 0.567 mv

Z4M-MAB = 0.778 mv = 1.93 μm LCP8-10 Z-Trans Plate = 0.517 mv = 0.5 μm

ME2/2-Trans Plate R= 0.523 mv = 2.4 μm ME2/2-ME2/1 R =1.039 mv = 4.7 μm

AD592 Temperature sensors σ = 1.032 mv = 0.10 deg K (typical 0.05 deg K)

Endcap Analog Sensors - ISR

Intermediate Term Resolutions: (one run period ~week)

Use data from normal cluster runs (cycles 8 measurements every 15 min); no Corrections, all points (LM302 off – 4 measurements /cycle)

σXtilt = 2.591 mv = 97.23 arc sec

σYtilt = 1.554 mv = 58.31 arc sec 12 V Analog Reference σ = 0.99 mv

Z4M-MAB = 1.295 mv = 3.21 μm LCP8-10 Z-Trans Plate = 31.60 mv = 28.80 μm

ME2/2-Trans Plate R= 4.66 mv = 21.30 μm ME2/2-ME2/1 R =10.36 mv = 47.04 μm

Endcap Analog Sensors - ISR

Intermediate term Drifts: Make a linear fit of July - August Data plotted in UNIX time
This sets a maximum drift limit in the data

Xtilt Vx = -0.02343 + 1.5924*10^{-8} T (volts); 0.031 v/2*10^{5} sec ; 19.38 arc minutes

Ytilt Vy = 0.5014 + 7.9544*10^{-9} T (volts); 0.016 v/2*10^{5} sec ; 10.00 arc minutes

Z4M-MAB = 2.9775 + 9.5305*10^{-8} T (volts); 0.0185 v/2*10^{5} sec ; 45.81 μm

ZLCP8-TP =9.4684 + 5.7215*10^{-9} T (volts); 0.0008 v/2*10^{5} sec ; 0.7 μm

ME2/2-TP R = 9.5070 + 2.5774*10^{-8} T (volts); 0.005 v/2*10^{5} sec ; 22.9 μm

ME2/1-ME2/2 R = 3.3942 + 1.4856*10^{-7} T (volts); 0.020v /1.5*10^{5} sec ; 90.8 μm

Endcap Analog Sensors - ISR

Long term Drifts: Make a linear fit of June - July - August Data plotted in UNIX time
Limit on drift by fit across 3.88M sec

Xtilt Vx = $-0.025328 + 9.2411*10^{-10}$ T (volts); 0.037 v/$3.88*10^{6}$ sec; 23.18 arc minutes

Ytilt Vy = $0.5014 + 7.9544*10^{-9}$ T (volts); 0.0018 v/$3.88*10^{6}$ sec ; 1.07 arc minutes

Z4M-MAB not available from fake MAB; only in previous July-Aug analysis

ZLCP8-TP different positions/setting in June vs July-Aug → adjust to real MAB

ME2/2-TP R = $9.5072 + 6.3963*10^{-10}$ T (volts); 0.002 v/$3.88*10^{6}$ sec ; 9.2 μm

ME2/1-ME2/2 R = $3.3502 + 1.4295*10^{-8}$ T (volts); 0.051v /$1.5*10^{5}$ sec ; 231.6 μm

Endcap Analog Sensors - ISR

Long term Resolution: Std Dev of June - July - August Data – fit across 3.88M sec
All data; no corrections, drift removal; other than ΔV shifts for LM302 data

Xtilt $\sigma Vx = 0.00258$ v = 1.615 arc minutes 12 V Ref $\sigma LV = 1.06$ mv

Ytilt $\sigma Vy = 0.00259$ v = 1.620 arc minutes

Z4M-MAB (intermediate); ZLCP8-TP different in June vs July-Aug → real MAB

Z4M-MAB $\sigma VZ4M = 1.295$ mv = 3.21 μm

LCP8-10 Z-Trans Plate $\sigma VLCP = 31.60$ mv = 28.80 μm

ME2/2-TP R $\sigma VR2 = 0.00363$ (volts) = 16.6 μm

ME2/1-ME2/2 R $\sigma VR1 = 0.02538$ (volts) = 115.3 μm

Endcap Analog Sensors - ISR

Sensor Conversions:

$\theta x(\text{tilt})(\text{arc deg}) = 10.4739Vx - 0.0963Vx^2 - 0.1714Vx^3 + 0.0025Vx^4 + 0.0026Vx^5$

$\theta y(\text{tilt})(\text{arc deg}) = 10.5002Vx + 0.1549Vx^2 - 0.1942Vx^3 - 0.0037Vx^4 + 0.0062Vx^5$

$Z_{4mW40}\ (\text{mm}) = (V_{Z4M} + 16.180)/(0.4038) + Z_{\text{Face position}}$

$Z_{LCP8\text{-}10}(\text{mm}) = (V_{LCP8})/(1.0987) + Z_{\text{ free point position}}$

$R_{LX\text{-}PA\text{-}2\text{-}1}\ (\text{mm}) = (11.928 - (V_{LX\text{-}PA\text{-}2\text{-}1}))/(0.2202) + R_{\text{ Zero Extension}}$ (ME2/1-ME2/2)

$R_{LX\text{-}PA\text{-}2\text{-}2}\ (\text{mm}) = (11.928 - (V_{LX\text{-}PA\text{-}2\text{-}2}))/(0.2188) + R_{\text{ Zero Extension}}$ (ME2/2-Tr Plate)